UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
WASHINGTON, D. C.
H. H. BENNETT, CHIEF
W. C. LOWDERMILK, ASSOCIATE CHIEF

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ADVANCE REPORT

on the

SEDIMENTATION SURVEY OF WEST FRANKFORT RESERVOIR

WEST FRANKFORT, ILLINOIS

August 19 - September 12, 1936

by

Victor H. Jones

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In Cooperation With

Illinois Agricultural Experiment Station
Urbana, Illinois
H. W. Mumford, Director

and

Illinois Department of Registration
Water Survey Division
Urbana, Illinois
A. M. Buswell, Chief

Sedimentation Studies
Division of Research
SCS-SS-15
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ADVANCE REPORT ON THE SEDIMENTATION SURVEY OF WEST FRANKFORT RESERVOIR WEST FRANKFORT, ILLINOIS

GENERAL INFORMATION

Location:

State: Illinois (fig. 1):

County: Franklin. Secs. 19 and 30, T. 7 S., R. 4 E. (Cave Township) and sec. 25, T. 7 S., R. 3 E. (Frankfort Township).

Distance and direction from nearest city: 6 miles east of West Frankfort, Ill.

Drainage and backwater: Tilley Creek, a small intermittent stream which flows northwestward from the dam approximately 2 miles to join Ewing Creek about 6 miles above its junction with the Middle Fork of the Big Muddy River.

Ownership: City of West Frankfort.

Purpose served: Municipal water supply.

Description of dam: The dam is an earth-fill structure 850 feet long, 27 feet in maximum height above the valley bottom, 100 feet wide at the base and 4 feet wide at the top. The upstream face has a slope of approximately 2:1 and is covered with a stone riprap to a height of 3 feet above crest level as a protection against erosion. The upper part of the dam is protected by a grass cover.

A concrete spillway dam extends across a small tributary channel just above its junction with Tilley Creek, and is separated from the northeast end of the main dam by a shoulder of glacial till 175 feet wide. This dam has a total length of 100 feet and a net crest length of 90 feet divided into 6 equal sections by concrete posts which make footing for flashboards 4 feet high. The spillway crest, without the flashboards, is 439 feet above sea level and 8 feet below the top of the main dam.

Peak floods have caused a volume of overflow considerably greater than the capacity of the spillway, and as a result the spillway fourdation has been partly undermined and the channel

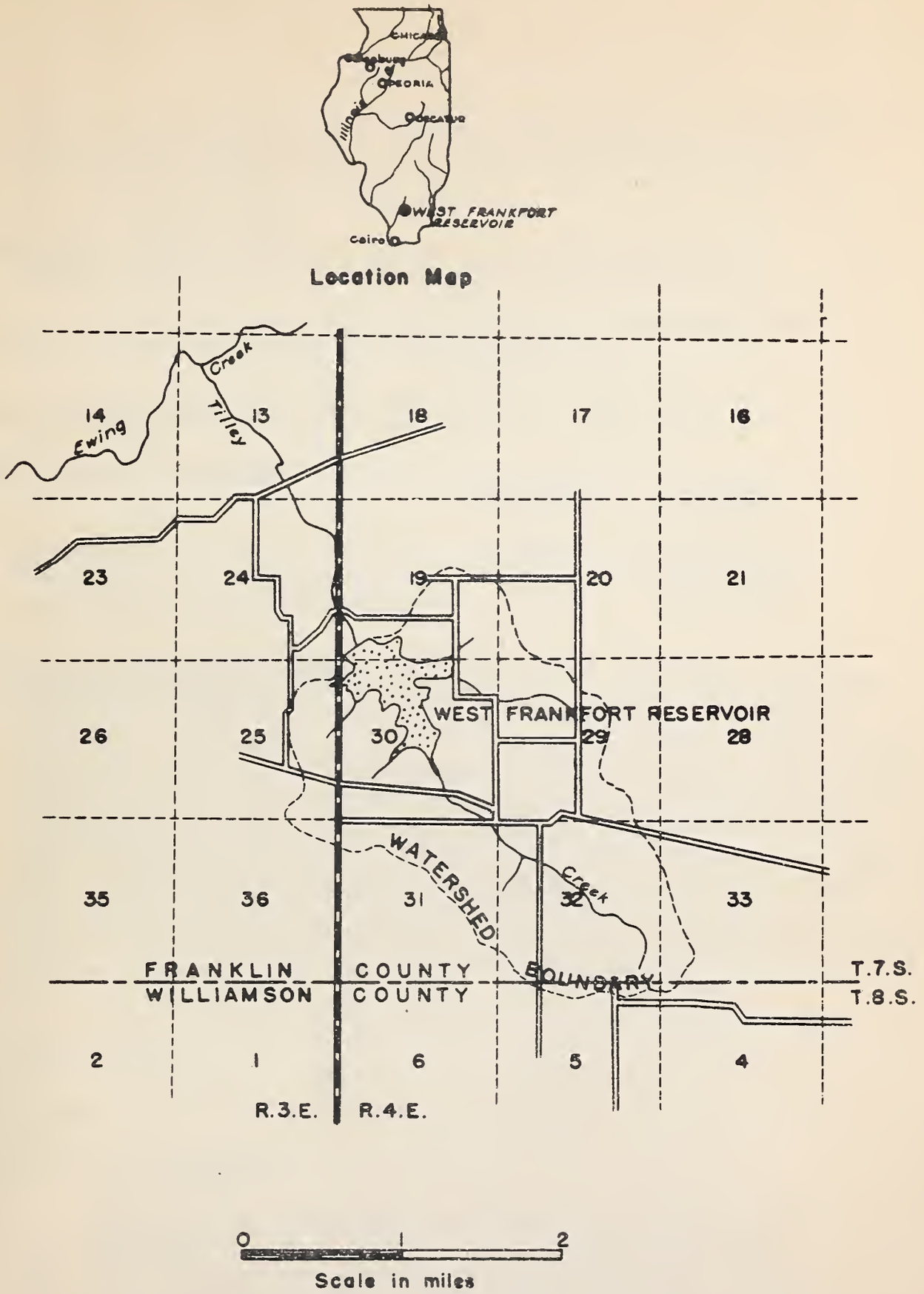


FIGURE 1.

LOCATION AND GENERAL RELATIONS OF WEST FRANKFORT RESERVOIR AND ITS WATERSHED

immediately below has been greatly deepened and widened (fig. 2). Overflow now drops about 4 feet from the lower end of the spillway chute into a plunge pool.

Date of completion: August 1926.
Average date of survey: August 1936. Age: 10 years.

Length of lake (original and present): 0.95 mile, not including 2,000 feet of ponded channel on Tilley Creek.

Area of lake at crest stage (original and present): 159 acres.

Storage capacity at crest stage:

	Acre-feet	Gallons
Original.....	1,175	382,873,750
Present.....	1,080	351,918,000
Loss by sedimentation.....	95	30,955,750

General character of reservoir basin: The lake proper is nearly 1 mile long and averages about 800 feet in width, narrowing gradually from about 1,200 feet near the dam to 350 feet at the upper end (fig. 3 following p. 9). The basin is comparatively shallow, and has a flat bottom broken only by stream channels cut 5 to 10 feet below the valley flat. The depth of the original basin was about 20 feet below crest level in the main channel near the dam and diminished uniformly toward the head of the ponded channel. The average gradient of the stream along its 1.32-mile stretch through the ponded area was 15 feet per mile. As the stream course did not meander widely and the depth of channel was fairly uniform, the slope of the valley flat was not greatly different.

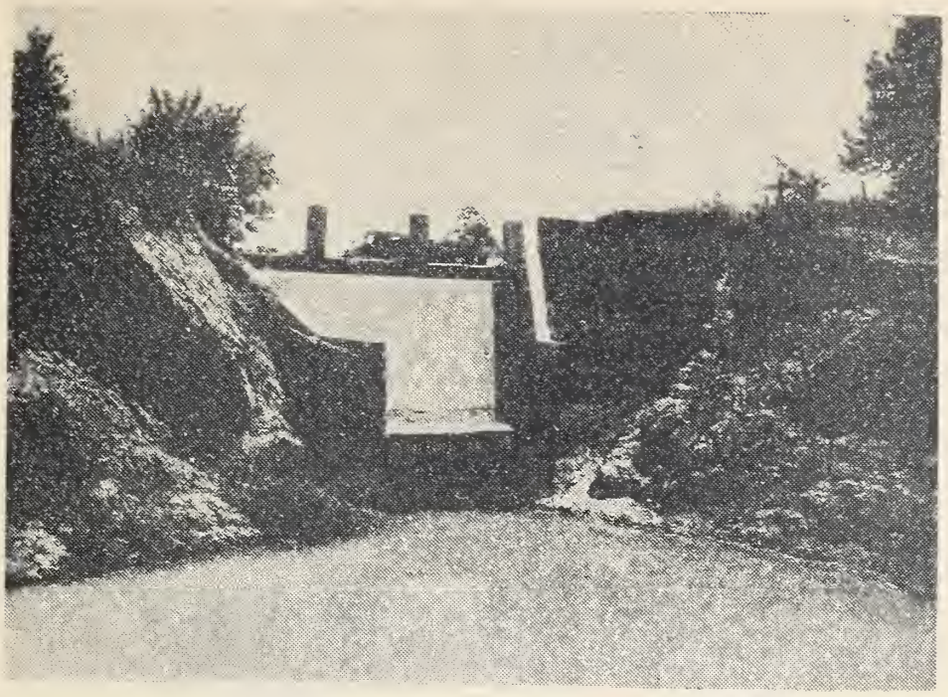
Slopes adjacent to the lake are gentle, averaging about 1.5 percent.

Area of watershed: 2,427 acres, or 3.8 square miles.

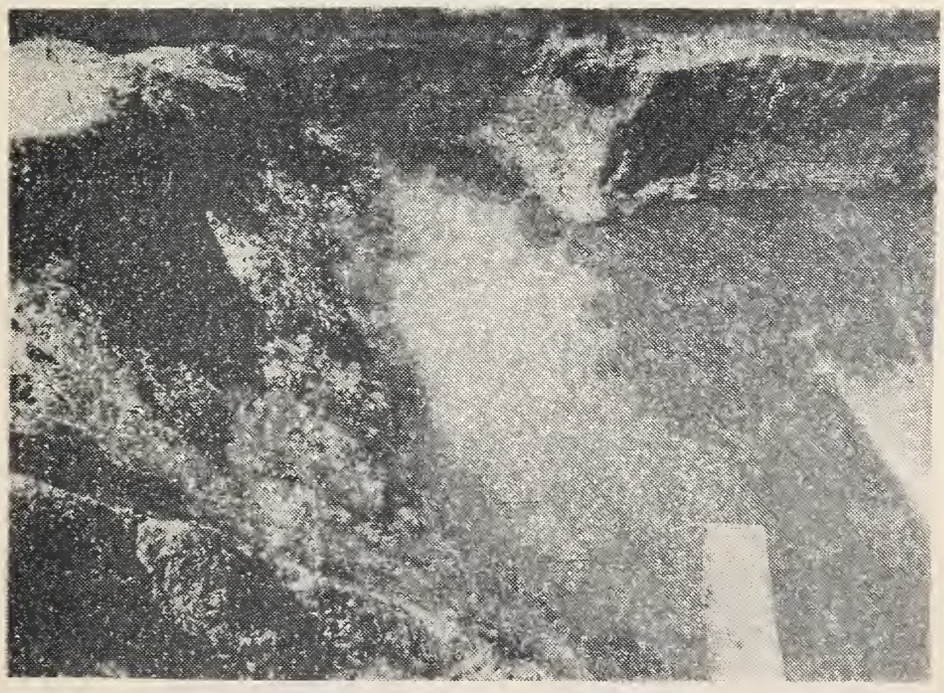
General character of watershed:

Geology.- The drainage area of the reservoir lies in the Till Plains section of the Central Lowland province near the southern margin of the Illinoian glacial drift. Bedrock outcrops are so rare that they have only an insignificant influence upon sedimentation in the reservoir. Table 1 lists the significant features of the surficial and underlying formations of the watershed. "Erosion" in this table refers only to accelerated erosion in excess of the geologic norm.

Figure 2.



A. Spillway of West Frankfort Reservoir, showing enlargement of channel occasioned by excess flood waters.



B. View downstream from spillway, showing enlarged channel.

Table 1.- Geologic formations of the West Frankfort Reservoir watershed

Age	Lithology	Thickness	Erosion
		Feet	
Cenozoic:			
Recent.....	Chiefly alluvial..... silts.	0-2	Exposed only in valleys not subject to accelerated erosion.
Pleistocene:			
Wisconsin 1/....	Alluvial silts..... sands and gravel.	0-8	Exposed only in main valley near dam.
Peorian.....	Loess.....	2-6	Severe erosion on uplands and slopes.
Sangamon.....	Loess.....	2-6	Moderate erosion on uplands and slopes.
Illinoian.....	Till, the upper part altered to gumbotil in places.	0-40	Exposed only on steeper valley slopes.
Pre-Illinoian 2/	Loess.....	0-2	Not important areally.
Paleozoic:			
Pennsylvanian: 3/			
McLeansboro.....	Sandstone and shale..	50-100	Exposed only in steep cut banks.
Carbondale.....	Sandstone, coal, shale and limestone	400	Not exposed.

The younger loess formations have a greater areal extent than the older formations, and therefore are the most subject to weathering, soil formation, and erosion. Not all ages of loess are represented at all localities, and identification of individual deposits is difficult in many places. Long continued leaching has deprived these formations of nearly all their calcium carbonate. The color of the loess is gray, buff, brown, or reddish.

1/ Shaw, E. W., and Savage, T. E. U. S. Geol. Survey Geol. Atlas, Murphysboro-Herrin folio (no. 185), pp. 5-10. 1912.

2/ MacClintock, Paul. Recent Discoveries of Pre-Illinoian Drift in Southern Illinois. Ill. Geol. Survey Div. Rept. Inv. no. 19, pp. 27-57. 1929.

3/ Cady, G. H. Coal Resources of District VI: U. S. Bur. Mines and Ill. Geol. Survey Div., Illinois Coal Mining Investigations, Bull. 15: 19-30. 1916.

Till of Illinoian age is exposed only in limited areas on steep slopes and cut banks where all loess has been removed. The bulk of this formation is a thoroughly leached and oxidized boulder clay containing sand, pebbles, and boulders, notably of sandstone. The uppermost part of the till is in many places altered to plastic, impervious gumbotil, which is detrimental to agriculture but contributes little sediment to the reservoir.

A very thin-bedded argillaceous sandstone of the McLeansboro formation is well exposed in a vertical bank 10 feet high on the west side of the Tilley Creek channel near the head of the lake. During an earlier geological period this sandstone was carved by erosion into hills and valleys which are now buried under glacial deposits. The upper surface of this sandstone, consequently, appears at various elevations around the lake, both above and below crest level. Relatively small quantities of silt and fine sand are added to the lake sediments by stream and slope erosion of the sandstone.

Topography.- Youthful to mature topography and a well-developed dendritic drainage pattern characterize the reservoir watershed. The highest point, near the boundary line between Franklin and Williamson Counties, is about 525 feet above mean sea level, or 86 feet above crest level of the lake. From the valley bottoms the slopes rise 20 to 40 feet within a quarter of a mile. True valley flats more than 500 feet wide do not occur in the watershed. All streams are intermittent.

The entire watershed lies on a low spur of loess-covered Illinoian till between two prongs of the ancient glacial Lake Muddy,[4] in which thick deposits of alluvial sediments were laid down in the valleys of all the major streams of the West Frankfort quadrangle.

Soils.- No detailed reports on the soils of the watershed have been published; however, comparison with soils described and mapped in neighboring areas by the Illinois Agricultural Experiment Station revealed that the soils of about 85 percent of the watershed, including all but the valley bottom soils, closely resemble the Ruford silt loam, mature phase, as described in Jackson County.[5] This soil occurs typically on the

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4/ Shaw, E. W., and Savage, T. E. op. cit. p. 5.

5/ Norton, E. A., Smith, R. S., DeTurk, E. E., Bauer, F. C., and Smith, L. H. Jackson County Soils. Ill. Agr. Expt. Sta. Soil Report 55: 20-22. 1933.

sloping lands adjacent to the stream courses, and has been developed largely on areas of Peorian loess. The surface soil, a brownish or yellowish silt loam, contains little or no calcium carbonate, making it desirable to add pulverized limestone in order to increase crop yields.

The soil of 15 percent of the watershed occurs on the creek bottoms, particularly in Tilley Creek valley near the reservoir. This valley soil is similar to soils in Jackson County that have been classified as Drury fine sandy loam,6/ and has been derived chiefly from material eroded from the adjacent slopes and subsequently deposited in the valleys. It is a yellow-brown or yellow-gray fine sandy loam ranging from a few inches to 4 feet in thickness, and is subject to frequent submergence during periods of heavy run-off.

Erosion conditions.- The hardwood forest which now covers approximately half of the watershed is effective in preserving the topsoil in most of the peripheral parts of the area. Along the slopes adjacent to Tilley Creek, however, many trees have been removed and all cultivated areas are undergoing considerable sheet erosion. Some uncontrolled gullies were observed in abandoned fields in the west half of section 32 (fig. 1). Although the slopes are moderate, erosion progresses swiftly in the powdery loess and loessial soils where they are unprotected by vegetative cover, especially when winter rains fall on partly frozen ground. The ensuing rapid run-off carries with it a heavy load of sediment derived from the uppermost soil zone.

Land use.- Franklin County and the surrounding region are best known as the largest coal-producing area in Illinois, and the chief industry of West Frankfort is mining. The watershed of Tilley Creek, however, contains no mines, and is essentially agricultural. No exact data on land use in the watershed are available, but the following figures, based on observations made during the survey, indicate the approximate proportions of the area devoted to the principal land uses:

	Percent
Forest (chiefly oak, hickory and walnut)	30
Pasture:	
Open	30
Wooded	20
Cultivated:	
Corn	10
Oats	5
Soybeans	5
	100

6/ Norton, E. A., et al. idem, p. 26.

Mean annual rainfall: 41 inches, according to records of the Illinois Water Survey Division.

Draft on reservoir: 400,000 to 500,000 gallons per day. Seasonal variation in water use is modified by the fact that increased domestic use during summer months is offset by marked decrease in industrial consumption. The mines and other industrial enterprises are most active during the winter season.

HISTORY OF SURVEY

The survey of West Frankfort Reservoir was made during the period August 19 to September 12, 1936, by the Central Reservoir Party, Section of Sedimentation Studies, Division of Research. The personnel of the party was as follows: Louis M. Glymph, Jr., chief of party, Victor H. Jones, assistant chief, William G. Shannon, Oscar D. Price, and Harry L. Fischer.

Original and present capacities and silt volumes were determined by the range method of survey.[7/] A triangulation net of 12 stations was expanded from a 1,075-foot base line across the dam, and served as control for mapping the shore line. Fourteen silt ranges were sounded and spudded, and all range ends and cut-in stations and the most important triangulation stations were marked with iron pipe stamped with the station numbers and set in concrete. Silt thicknesses were measured with the standard spud, and soundings were taken with a specially designed 5-pound conical aluminum weight. An unusually low water stage of 4 to 5 feet below crest prevailed during the survey, as practically no rainfall had occurred in the area during the preceding three months. All mapping was done with plane table and telescopic alidade on a scale of 1 inch to 200 feet.

Under the terms of a cooperative project agreement with the Illinois Agricultural Experiment Station and the Water Survey Division of the Illinois Department of Registration, the field party assisted in the collection of silt samples for chemical analysis of plant-food elements. Pint samples of bottom sediment from 12 localities distributed over the reservoir were taken by means of a special tubular sampler, and were preserved in the wet condition. The collection of samples was supervised by F. H. Crane, assistant chief, Division of Soil Fertility, Illinois Agricultural Experiment Station. Analyses are now being made at the Experiment Station, and the results will be incorporated in the final report on this investigation.

7/ Eakin, H. M. Silting of Reservoirs. U. S. Dept. Agr. Tech. Bull. 524; 129-135. 1936.

ACKNOWLEDGMENTS

The Soil Conservation Service acknowledges the generous cooperation of the municipal authorities of West Frankfort, particularly the city water department, in authorizing and expediting the survey. John Misker, former superintendent of the water department, supplied information on the construction and history of the reservoir and data on local water consumption. John Simmons, the present superintendent, furnished material for the construction of survey monuments.

SEDIMENT DEPOSITS

Character of sediment.- The texture of the reservoir sediment, as determined by field examination, ranges from fine sand to clay with a predominance of silt-size particles. It is not markedly tenacious when wet, and is readily removed from the spud by a few quick sweeps through the water. Toward the dam in deeper water the proportion of clay increases and the sediment is slightly more tenacious. Partly carbonized leaves, twigs, and bark are abundant in the sediment near the head of the lake, and an especially persistent stratum of vegetal material occurs at the bottom of the deposit. Plant debris is abundant also in segments 8 and 9, near the head of the east arm of the lake.

The color of the sediment is predominantly light to medium gray with occasional streaks of black or bluish carbonaceous material. The gray color is produced by continued submergence of the loess-derived silts resulting in reduction of iron minerals. Where the sediment is periodically exposed to the atmosphere during low-water stages, it is reoxidized to the brown or buff color of the loess on the adjacent slopes. The exposed sediment is locally sun-cracked and supports a luxuriant growth of fine new grass.

Sub-silt materials.- In most places the bottom of the silt is defined by an immature soil which was developed upon the pre-lake valley silts. It differs little in texture, but is consistently more tenacious and contains sufficient humus to have a dark brown color. Rootlets of grass and related plants, or root tubules occur abundantly in it. In the submerged channel the pre-lake sediment is chiefly oxidized sand of rather uniform medium to fine texture. It has no tenacity, and is conspicuously different from the lake silts.

Distribution of sediment.- In general, the thickness of sediment increases from the dam to the head of the lake. On range R1-R2, near the dam, the silt has a maximum depth of 0.9 foot in the submerged channel, and an average depth of about 0.5 foot on the adjacent flat areas. (fig. 3, following p. 9). On range R17-R18, midway between the dam and the head of the reservoir, the silt depth is about 1.5 feet in the channel and 0.6 foot on the flats. Measurements on range R22-R23, near the head of the open lake,

showed that in the channel the silt is 3.1 feet thick and on adjacent flats it is about 2 feet thick near the channel and gradually thins out at or near the crest-level shore line. On range R24-R25, at the lower end of the ponded channel of Tilley Creek, only insignificant amounts of sediment were found, indicating that the bulk of the incoming silt load is carried through the restricted ponded channel into the open lake before appreciable deposition occurs.

A relatively large body of fine sediment has accumulated in the east arm of the reservoir, especially in segment 9. Here the maximum silt depth, as determined on range R11-R12, is 4.8 feet in the channel, and the average depth across the flat is nearly 2 feet.

Only insignificant areas of sediment have accumulated above crest, and no deltas have yet formed, although, if sedimentation continues at the same rate, they will probably appear at the heads of the two principal arms within another 10 years.

A considerable fraction of the incoming fine sediment does not settle in the reservoir but is carried through it and over the spillway, as shown by the high turbidity of the overflow during flood seasons.

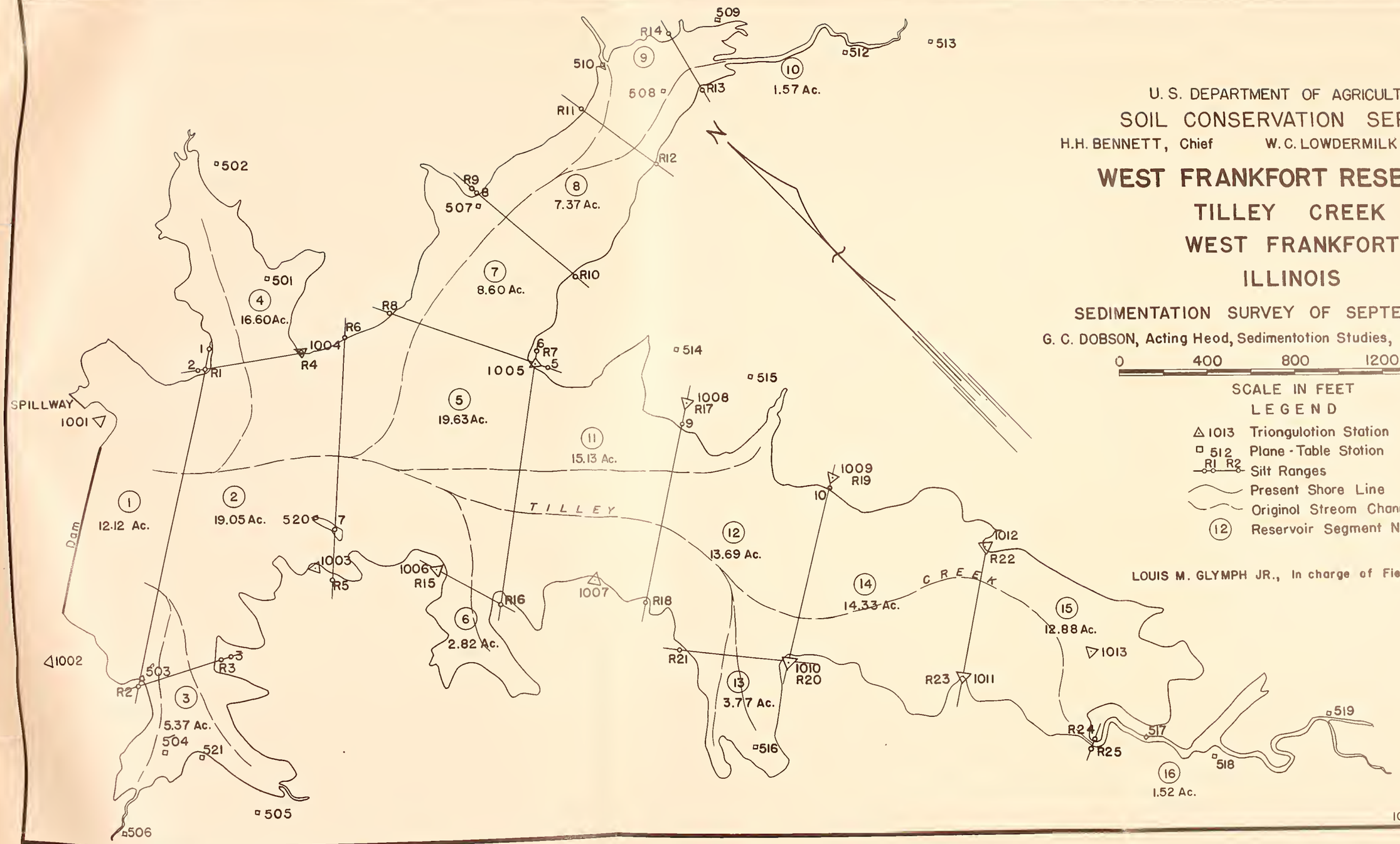
Origin of sediment.- Nearly all of the lake sediment has originated from the abundant and widespread loess formations and loess-derived soils of the watershed. Areas of most active erosion which furnish the greater part of the sediment are: (1) slopes in cultivation or open pasture immediately adjacent to the reservoir, (2) cultivated fields in the northeast quarter of section 30 and the southeast quarter of section 19 (fig. 1), and (3) areas undergoing gully and sheet erosion in the north half of section 32. Small scattered outcrops of sandstone and till contribute unimportant quantities of silt and fine sand.

The following tabulation is a statistical summary of data relative to West Frankfort Reservoir, West Frankfort, Ill.

	Quantity	Unit
Age: 1/	10.0	Years
Watershed:		
Total area	3.79	Square Miles
	2,427	Acres
Reservoir:		
Original area at crest stage	159	Acres
Present area at crest stage	159	Acres
Original storage capacity	1,175	Acre-feet
Present storage capacity	1,080	Acre-feet
Original storage per square mile of drainage area	310.03	Acre-feet
Present storage per square mile of drainage area	284.96	Acre-feet
Original storage per acre of drainage area	5.81	Acre-inches
Present storage per acre of drainage area	5.34	Acre-inches
Sedimentation:		
Delta deposits, Botton-set beds	Not measured separately	
Total sediment	95	Acre-feet
Accumulation per year average	9.5	Acre-feet
Accumulation per year per 100 square miles drainage area	251	Acre-feet
Accumulation per year per acre of drainage area	170.51	Cubic feet
Or, assuming average weight of one cubic foot of silt is 100 pounds	8.52	Tons
Depletion of storage:		
Loss of original capacity per year	0.81	Percent
Loss of original capacity to date of survey	8.09	Percent

1/ Date storage began: August 1926.
Date of this survey: Aug. 19 to Sept. 12, 1936.

Fig. 3



U. S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

H.H. BENNETT, Chief W.C. LOWDERMILK, Associate Chief

WEST FRANKFORT RESERVOIR

TILLEY CREEK

WEST FRANKFORT

ILLINOIS

SEDIMENTATION SURVEY OF SEPTEMBER, 1936

G. C. DOBSON, Acting Head, Sedimentation Studies, Division of Research

0 400 800 1200 1600

SCALE IN FEET

LEGEND

△1013 Triangulation Station

□512 Plane-Table Station

R1 R2 Silt Ranges

Present Shore Line

Original Stream Channel

(12) Reservoir Segment Number

LOUIS M. GLYMPH JR., In charge of Field Survey

10-19-36 N-782